CHAPTER 8

University–industry links—the big picture

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INTRODUCTION

The production of knowledge and the process of research are being radically transformed and these changes can directly affect the way in which many doctoral candidates undertake their research. The old paradigm of knowledge discovery ('Mode 1') circumscribed by disciplinary research and driven by the autonomy of researchers and their host institutions, the universities, is being superseded—but not replaced—by a new paradigm of knowledge production ('Mode 2'). 'Mode 2' research is done by teams of researchers who typically have different disciplinary backgrounds, theoretical perspectives and skills and who assemble to work on a real world problem in the context of its application, necessitating much closer links between the researchers and the users of the research. Researchers are brought together to form a team to address a problem. This team may be a virtual team, the members of which communicate electronically. The team dissolves when its work is finished only to be re-configured in a different constellation for another task (see Gibbons et al 1994).

A relatively low proportion of graduates of contemporary Australian and New Zealand doctoral programs will spend their entire careers as academics in universities. All over the world, non-university employers of doctoral graduates such as research institutes, government departments and industry now need researchers who can operate effectively in this 'Mode 2' environment. Research training is being modified to meet this requirement catalysed in Australia by government policy initiatives such as Cooperative Research Centres, the Australian Research Council (ARC) Linkage Scheme and encouragement for

science agencies such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to become more involved in research training. In New Zealand the Foundation for Research Science and Technology (FRST) has similar initiatives through its Consortia program and its Enterprise Scholarships. These initiatives provide increased opportunities for Australasian research higher degree candidates to undertake projects that are wholly or partially funded by industry (including government) partners. In order to undertake such a project you may be based off-campus at a government or industry research laboratory.

Like most other initiatives, there are costs and benefits of being associated with an industry-funded doctorate. Such an arrangement is not optimal for all candidates—think carefully before you commit yourself. The purpose of this chapter is to help you make an informed decision about whether an industry-funded doctorate is the right choice for you, and if you decide that it is, how to make the most of such an opportunity.

KNOW YOURSELF

Undertaking a doctorate is a multi-year investment for you, your family, your supervisor(s), the university, and in the case of an industry-funded doctorate, the industry partner. Before you sign up for a doctorate, it is important to undertake some hard-nosed self-reflection. The need for such reflection is particularly acute for an industry-funded doctorate which typically involves a formal contract between your university, your supervisor and the industry partner. This contract commits everyone involved to delivering specified outcomes—including your doctoral thesis. Failure to deliver will adversely impact on everyone involved, especially you, and will almost certainly affect the willingness of the industry partner to invest in other doctoral candidates.

I recommend that you work through the questions at the end of this chapter with someone completely independent of your research life, such as a career counsellor. Your potential supervisor(s) may have a vested interest in signing you up to do the doctorate and may assume that your preferences and aspirations are similar to their own. Talk it over with those closest to you as well. Remember you are making a decision that will affect your future career. You need to make an informed choice.

CLARIFY YOUR COMMITMENT

If you make an in-principle decision to go ahead, ask to see the contract between your university and the research provider and go through this contract with the guidance of a lawyer so you fully understand the commitments you are making. The university should provide you with independent legal advice through the student association, especially if there are intellectual property issues with

the potential to affect the examination of your thesis and your rights to publis certain sections of your work.

THE BENEFITS OF AN INDUSTRY-FUNDED PROJECT

Some candidates are attracted to an industry-funded doctorate by the associatec financial benefits which may be considerable. The stipends offered are usuall considerably higher than a typical scholarship (up to about 30 per cent higher than standard stipends is not unusual). Be careful to check with a Scholarships Officer at your university as to whether the scholarship will be tax free; your tax obligations may negate the increased scholarship stipend. In some cases, the industry partner provides a top-up scholarship in addition to the standard scholarship. It is important for you to check the duration of such scholarships and top-ups to make sure you will have sufficient time to complete the university requirements for your doctorate.

Another advantage of an industry-funded doctorate is guaranteed and often substantial project support. Such funding generally enables candidates to attempt projects that would not be feasible without external funding. Industry partners may also provide generous in-kind support such as travel to remote study sites, access to specialist infrastructure including instrumentation and data sets, plus the expertise of industry supervisors.

Many doctoral candidates are attracted to industry-funded projects by the opportunity to make a difference and work on an important real world problem in a 'Mode 2' team research environment. Working in a transdisciplinary research team is exciting and the experience has the potential to lead to opportunities for work placement and other interactions with key stakeholders. All this may lead to future employment. Such experience also equips you to work in modern research agencies and industry much better than a traditional doctorate does and should greatly expand your employability, especially outside academia.

The research training environment of an industry-funded doctoral project can also be extremely supportive. In particular, some industry-funded research centres supporting significant cohorts of research students can offer:

- professional assistance with thesis writing and statistics over and above that offered by the university
- generic skills courses such as media and leadership training
- the opportunity for candidates to present their work at centre-sponsored conferences and workshops
- travel scholarships to assist candidates present their work at international conferences
- write-up scholarships which support candidates to write papers from their theses in the period between thesis submission and the return of examiners' reports
- work placements and so on.

All these offerings can greatly enrich your doctoral training environment and potential employability.

When the industry partner is a government department, a useful by-product of an industry-funded doctorate is the experience of translating doctoral research into a policy briefing. For example, a group of candidates at the CRC Reef Research Centre with which I am involved has organised several industry workshops for the end-users of their research. The outputs of these workshops include oral presentations on each candidate's doctoral research and written policy briefings which have been published on the Internet. Most doctoral candidates find writing a policy briefing based on their research to be a demanding task—but the experience looks very good on their résumé.

THE CHALLENGES OF AN INDUSTRY-FUNDED PROJECT

Despite these advantages, candidates who undertake industry-funded doctorates also face significant challenges. The research project has usually been defined in detail so that the candidate does not have the same freedom to choose a topic as his or her peers on national or university scholarships. The supervisor and industry partner have put a lot of effort into designing the project and as a result have a strong sense of ownership over it and may be unwilling for it to be changed. Indeed, they may be prevented from making substantive changes to the project by their contractual obligations. So if you feel that the opportunity to choose your research question and design your project is an essential part of the doctoral experience then an industry funded doctorate is not for you. You should also check that you have the freedom to vary your project to take advantage of serendipitous discoveries. I suggest you explore this matter explicitly with your supervisor(s) and industry partners before enrolment. The opportunity to recognise and explore exciting discoveries is crucial to your development as an independent researcher and should not be unduly curtailed, as long as it does not interfere with the agreed outcomes of your doctoral project.

There are also academic challenges to doing a doctorate that have to meet both the demands of the university and deliver the outcomes required by the industry partner. Industry-funded research is usually applied and some staff in your university department may be concerned that it may be difficult for you to incorporate the scholarship necessary for doctoral research into your thesis. In my experience the challenge of meeting these competing demands is more perceived than real, provided your research question is appropriate for a doctorate.

The ownership of intellectual property (IP) may be an issue and candidates can feel pressured into IP agreements that they do not understand and which can impede the examination and publication of the research. If you are expected to assign your IP in the project make sure you understand what this means. Consider carefully any consequential restrictions the IP agreement may impose

on the publication and examination of your doctoral work. The advice of an independent lawyer is essential in such circumstances.

COMPETING DEMANDS OF ACADEMIA AND INDUSTRY

Scholarship

The demands of a thesis, particularly the demand that it make a significant contribution to a field, calls upon the candidate to become a reflective and critical reviewer. One of the best ways to meet the academic demands of the university is to ensure that your review of literature for the project is 'thorough, scholarly and substantive'. The review is used to inform and position your research and to establish its 'originality' and contribution to the field. To ensure you have mastery of the relevant literature, I suggest you write a formal, scholarly literature review early in your candidature even if it is not required as part of your confirmation of candidature process. This material can then be revised and included in your thesis, either as a separate chapter or in the introductions to the data chapters. You should also re-visit the literature in your final discussion.

Publications and other forms of reporting your results

You may be required to provide regular reports which are accessible to key stakeholders, especially your industry partner. University supervisors are often inexperienced in helping a candidate develop the practical and policy implications of the research: the aspect of most interest to the industry partner. Industry partners can be very helpful in making your reports accessible to a non-specialist audience.

When you are required to present your results verbally, target your presentation to your audience. Remember that a talk prepared for an academic audience will probably have to be revised drastically to be useful for an industry audience. Again, the advice of your industry partner can be invaluable in ensuring that your presentation is accessible to an industry audience. Make sure you invite them to the rehearsal!

Notwithstanding the importance of presenting material for your industry partner, the main process by which the quality and contribution of academic research is judged is 'peer review'. Review by academic peers underpins every aspect of academic life from promotion through to grant application. The doctoral process is no exception. Today it is often expected that candidates in Australia or New Zealand will publish or at least submit a paper to be reviewed prior to thesis submission. Publishing research during candidature has two advantages for an industry-funded doctoral candidate. Peer-reviewed publication prior to submission evokes positive examiner comment. In addition, presenting

your work in publishable 'chunks' is an effective way of reconciling the disparate time lines of academia and industry. Academic groups tend to operate on a three-year cycle dictated by the tenure of the doctorate and major research grants. In contrast, industry partners, especially small and medium sized enterprises, operate on much shorter research and development schedules or want access to results throughout the research process. Producing papers with plain English summaries designed for your industry partners is an effective way of satisfying both your audiences, but remember to publish in the peer-reviewed academic literature, irrespective of any requirements for you to provide reports to your industry partner.

Authorship is one of the most contentious aspects of the publication process. Arguments over authorship are very disrupting to good relationships, especially when working in a transdisciplinary team environment. Make sure you understand the norms of your discipline(s) and the expectations of the other members of your team well in advance of writing the first draft of any publication or report. In fact, expectations regarding authorship of refereed publications is one of the issues to be explored early in an industry-funded doctorate and should definitely be on that checklist of matters to be discussed with your supervisor(s) and industry partner(s).

Thesis examination

Since the thesis is normally the sole basis for the award of an Australian or New Zealand doctoral degree and since the originality of the research is a defining feature of the degree, examiners must have all necessary information to be able to judge the extent to which the most significant work presented in the thesis is the candidate's own. As previously explained, industry-funded 'Mode 2' research is done in transdisciplinary teams and research candidates are encouraged to access assistance beyond their supervisory panel including technical, editorial, or statistical support provided by their university, external collaborators or even commercial providers. Examiners must be fully aware of these contributions to make their assessment of the candidate's achievements. So that the examiners can make this assessment, most universities require each doctoral thesis to be prefaced by a statement disclosing the relative contributions of the respective authors to any multi-authored papers included in the thesis and the contribution by others to the research findings in the thesis. Such statements should be signed by the candidate, principal supervisor and head of department.

BUILDING EFFECTIVE RELATIONSHIPS

Effective relationships are built on agreed expectations, trust, communication and commitment. An effective partnership requires all parties to address these

aspects of the relationship. Recent doctoral research on university-industry relationships found that partnering competence is a higher priority than scientific excellence for firms choosing and trusting university partners. Candidates doing a doctorate with industry partners thus have an excellent opportunity to develop partnering skills which should be very relevant to their career development and equip them to work in the 'Mode 2' environment.

There are several strategies that research higher degree candidates (and their supervisors) can use to enhance communication between the often-disparate cultures of industry and academia. One strategy is to develop a checklist of matters to be discussed early in candidature to ensure that everyone has similar expectations. Another productive strategy is to appoint a 'task associate' to ensure that the candidate and the supervisor have a nominated point of contact with the industry partner. The task associate or mentor should then be involved both in regular reports to industry and in university candidature milestones such as the confirmation of candidature so that they have the opportunity to gain first-hand experience of university requirements and processes. Task associates are not only required to comment on the quality and relevance of the research results, but also on their contact with the candidate.

FROM DOCTORATE TO EMPLOYMENT

Candidates who are supported by an industry-funded project typically gain much more than their degree. First of all, they gain the skills required to operate in a 'Mode 2' research environment. These skills can be enhanced if the candidate has the opportunity to negotiate a workplace placement or technology transfer scholarship to gain experience in working for the industry partner and perhaps assist in implementing the outcomes of the doctoral research. Such placements often lead to employment with the industry partner.

A word of warning—if you have an opportunity to undertake such a placement or to get a job with your industry partner, I strongly advise you to finish your thesis first. Most doctoral candidates find it very distracting to cope with the competing demands of a job and finishing a doctorate and the last six months of candidature often stretches to 18 months, which is not a good outcome for you, your university or your industry partner.

Research agencies, government departments and industry often complain about the challenge of recruiting doctoral graduates with the skills required to operate effectively in their workplaces. Undertaking an industry-funded doctorate can be an effective way of preparing yourself to work in the new knowledge economy if you make the most of the opportunity and feel comfortable working in such an environment.

QUESTIONS

1 How important is it for your doctorate to 'make a difference' by working on a real-world problem with an industry partner?
2 How might working on an industry-funded project help you fulfil your career aspirations?
3 Where do you see yourself fitting into the project team for an industry-sponsored project alongside your supervisor(s) and the industry partner?

REFERENCE

Gibbons, MC, Limoges, C, Nowotny, H, Schwartzman, S, Scott, P, & Trow, M 1994, *The new production of knowledge: The dynamics of science and research in contemporary societies*, Sage, London.